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(54) Coatings

(57) A rigid object, such as a fibre reinforced plastic aerospace component, is coated with a material producing visible stain on the application of a predetermined pressure; thus, for example, providing a visible indication that the object has sustained an impact which might have

caused structural damage. The coating may comprise a pre-coat or primer layer, a reactor layer containing a first chemical, a second layer containing encapsulated in gelatine microcapsules a second chemical which, when released by rupture of the microcapsules, reacts with the first to produce a stain, and a protective layer.

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SPECIFICATION Coatings

This invention relates to coatings. More particularly the invention relates to coatings applied to rigid objects so that it can be determined when such objects have had a pressure at or above a predetermined pressure produced either by a sustained or an impact pressure applied to them and are therefore likely to have become damaged.

It is known to coat paper with materials which give a stain when pressure is applied to them. The coating is such that no staining occurs during ordinary handling but staining occurs when there is impact from, for example, a printing type member. The principal object in such cases is to provide sensitized paper that will generate a physical mark when struck to give the effect of printing and this is described, for example, in GB 546 749.

According to the present invention a rigid object is coated with a material so constituted that visible stain is generated in the coating at any area subjected to a pressure at or above a predetermined pressure. Preferably the coating includes two chemicals which are kept separate until subjected to a pressure at or above a predetermined pressure and then are released so that they interact to produce a stain.

Rigid objects such as components used in aerospace applications, reinforced plastics composite windings, and filament wound plastic structures when hit with an impact resulting in an applied pressure above a certain predetermined pressure are damaged but may not show any visible signs of being damaged. When such a rigid object suitably coated according to the present invention is subjected to pressures at or above the predetermined pressure known to cause damage a visible stain occurs so that the object is clearly shown to have had such a pressure applied to it and may be damaged. The object can then be examined in greater detail or tested to find out if it is damaged. If found to be damaged the object can be repaired or discarded. This can prevent failure of the object, such as a component used in aerospace application, in use.

In one embodiment in the first and second chemicals are respectively contained in first and second layers of the coating and the first layer is preferably sufficiently opaque to contrast the stain. This first layer may comprise a reactor powder and a liquid binder.

In a preferred embodiment the second layer comprises rupturable capsules containing one of the chemicals. The capsules are preferably made of gelatin. Alternatively the capsules may be made of agar-agar gum or of a mixture of agar-agar gum and gelatin. It is preferable to have a base pre-coat layer underneath the coating which produces the stain and to have a protective layer on top of the coating producing the stain.

The coating which produces the stain is preferably applied to the object electrostatically.

Different objects are damaged at different impact pressures and the thickness and composition of the coating can be selected accordingly so that visible stain only occurs when the applied pressure exceeds the pressure at which it can safely be said that no damage will have occurred to the object in question.

The invention may be carried into practice in various ways and a number of specific embodiments of the invention will now be described by way of example.

A composite winding made of resin impregnated strands wound on a mandrel and then cured so that the mandrel can be removed is used as the rigid object to be coated. First a base pre-coat layer is applied which acts as a primer for the system.

A first layer termed the reactor layer is then applied. This contains one of the stain producing chemicals and is sufficiently opaque to contrast the colour of the dye produced. It is not very stable and is prepared freshly from a reactor powder and a liquid binder in ratio of from 30 to 55 (preferably 40) parts by weight of powder to from 70 to 45 (preferably 60) parts by weight of binder. Over the top of this is applied a second layer containing the other stain producing chemical encapsulated in gelatine particles. This is termed the capsule layer. The temperature at which the capsule containing layer is preferably stored is at a temperature within the range $+10^{\circ}\text{C}$ to $+35^{\circ}\text{C}$. The composition containing the capsule must be agitated thoroughly before it is applied and then applied within 15 to 20 minutes. The layer should be dried for 12 to 16 hours after application. The capsule containing layer bubbles badly if it is exposed to high humidity or water. Some control of humidity during drying is preferable. This layer contains capsules of gelatine each containing dye or a dye producing material. A protective layer is put on top of the coating producing the stain. This acts as a barrier against moisture, weather etc. The protective layer should be allowed to dry for at least 12 hours at a normal room temperature.

The composite coating if hit with an impact producing pressure at or above a certain pressure will rupture the gelatine capsules in the capsule containing layer releasing the contents so that there is a reaction between the contents of the capsule containing layer and the reactor layer to produce a visible stain. The colour of the stain so produced is contrasted against a white background by the use of a white filler in the reactor layer and is visible through the protective layer.

The coating which produces the stain is preferably applied electrostatically.

In an alternative embodiment the composite winding may be coated with a liquid emulsion having a continuous phase and a plurality of discontinuous phases. The emulsion is converted to a solid having a continuous phase and a plurality of liquid discontinuous phases which are chemically reactive and when the object is subjected to a pressure at or above a

predetermined pressure the chemically reactive discontinuous phases coalesce to produce visible stain. Suitable formulations are described in GB 546 749 and GB 646 926.

- 5 In a further embodiment the coating may contain discrete liquid inclusions of colouring matter and when a pressure at or above a predetermined pressure is applied the coating ruptures and the liquid inclusions are released at the impacted area so that a visible stain appears. Suitable formulations are described in GB 546 750, GB 759 800, GB 773 180 and GB 828 983.
- 10 In another embodiment the coating consists of a solid binder which includes in intermingled dispersion, and insulated from one another, particles of different solid substances which produce a visible stain or distinctive colouration as a result of a physical reaction when they undergo mutual contact when a pressure is applied and the binder is ruptured. Suitable formulations are described in GB 628 960.

CLAIMS

- 25 1. A rigid object coated with a coating so constituted that visible stain is generated in the coating at any area subjected to a pressure at or above a predetermined pressure.
2. An object as claimed in Claim 1 in which the

- 30 coating includes two chemicals which are kept separate until subjected to a pressure at or above a predetermined pressure and then are released so that they interact to produce a stain.

3. An object as claimed in Claim 2 in which the first and second chemicals are respectively contained in first and second layers of the coating.
- 35 4. An object as claimed in Claim 3 in which the first layer is sufficiently opaque to contrast the stain.

5. An object as claimed in Claim 4 in which the first layer comprises a reactor powder and a liquid binder.

6. An object as claimed in any of Claims 3 to 5 in which the second layer comprises rupturable capsules containing one of the chemicals.

- 45 7. An object as claimed in Claim 6 in which the rupturable capsules are made of gelatine or agar-agar gum or a mixture thereof.

8. An object as claimed in any one of Claims 1 to 7 in which there is a base pre-coat layer underneath the coating which produces the stain.

- 50 9. An object as claimed in any one of Claims 1 to 8 in which there is a protective layer on top of the coating producing the stain.

10. An object as claimed in any one of the preceding claims in which the coating which produces the stain is applied electrostatically.

11. A rigid object coated substantially as described herein.

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